

**First Records for *Cyclosomus inustus* Andrewes  
(Coleoptera: Carabidae: Cyclosomini) for Taiwan,  
with Notes on Habitat and Behavior**

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*Cyclosomus inustus* Andrewes is reported for the first time since 1924 and for the first time in Taiwan. The habitat distribution and feeding behavior of adults of this species are discussed and illustrated, and a checklist of carabid species inhabiting sandy sea beach habitats in northern Taiwan is provided and illustrated.

KEYWORDS: Coleoptera, Carabidae, Cyclosomini, *Cyclosomus*, Taiwan, sandy sea beach fauna

The first two authors [LJW and JJC] conducted field investigations of the coastal carabid fauna of northern Taiwan during the period June 2005 to March 2017. In August, 2008, early in this study, they discovered and collected specimens of a species of *Cyclosomus* Latreille, a genus recorded from the Afrotropical and Oriental Regions but previously unknown from Taiwan. Based on his study of the genus for the Oriental Region (manuscript in preparation), the third author [DHK] was able to confirm their identification as members of *Cyclosomus inustus* Andrewes. Over the remainder of the study period, the lead authors continued their collections and observations of this species.

The purpose of this report is to document this first record of this species for Taiwan, describe its known geographical and habitat ranges on the island as well as observed activity and feeding behavior of adults of this species for the first time.

**MATERIAL AND METHODS**

Field observations were made on a monthly basis throughout the study period, June 2005 through March 2017. Temperature of sandy ground was measured using a non-contact infrared thermometer (model DIT 501A, TECPEL, Taipei, TAIWAN). Specimens collected were examined in the laboratory using a Leica MZ125 stereomicroscope and have been deposited in the following collections:

CAS	California Academy of Sciences, San Francisco, California, U.S.A.
CWT	L. J. Wang collection, Taipei, Taiwan.
NMNS	National Museum of Natural Science, Taichung, Taiwan
NMW	Naturhistorisches Museum Wien, Vienna, Austria
TFRI	Taiwan Forestry Research Institute, Taipei, Taiwan
ZSM	Zoologische Staatssammlung München, Munich, Germany

***Cyclosomus inustus* Andrewes in Taiwan***Cyclosomus inustus* Andrewes, 1924:464-465. Type locality: Hong Kong.

Adults of this species are moderate in size (body length 7.0 to 8.7 mm), with a broadly ovoid and flattened body form. The base of the pronotum is only slightly narrower than the base of the elytra, giving these beetles a very stocky appearance, similar to that of many water beetles and especially to members of the carabid genus *Omophron* Latreille. However, they are so distinctive among beetles of the Taiwanese fauna that they cannot be confused with any other species recorded from the island. Two particularly distinctive features include: (1) markedly modified front legs, with the lateral portion of the apex of the tibia expanded laterally, and the first and second (and to a lesser extent the third) tarsomeres with distinct finger-like lateral projections; and (2) hind legs with the medial spur of the tibia markedly elongate, nearly equal in length to the first tarsomere. No other Taiwanese carabid shares this combination of features, both of which are considered modifications for life in or on dry sand.

**VARIATION IN COLOR PATTERN.**— In Taiwan, variation in color pattern seen among adults of this species is illustrated in Fig. 1. Color of the pronotal disc ranges from reddish brown (Figs. 1A–C) to dark brown or piceous (Fig. 1D). The color of the basal one-eighth of the elytra from the midline to elytral stria 5, together with the full length of elytral interval 1, ranges from reddish brown to black among individuals, and teneral specimens may have these areas entirely pale. The elytral “middle dark band” may be represented by a relatively thick, dark, jagged, roughly V-shaped band extended laterally onto interval 7 on each side (Fig. 1D), by a thinner, paler yet narrowly continuous band (Fig. 1C), or by reduced and disconnected vestiges of that band (Figs. 1A and 1B). The full range of this variation is seen within populations, so it appears to be simply individual variation and without an evident geographical component.

**MATERIAL EXAMINED (A TOTAL OF 160 SPECIMENS).**— **TAIWAN:** *New Taipei City*, Shihmen, Lingshanbi, 30.VIII.2008, J. J. Cherng collector, 8 specimens (TFRI); same locality, 7. IX. 2008, L.J. Wang & J.J. Cherng collectors, 16 specimens (TFRI); same locality, 4.X.2008, J.J. Cherng collector, 2 specimens (TFRI); same locality, 23.V. 2009, J.J. Cherng collector, 5 specimens (TFRI); same locality, 10.VII. 2010, J.J. Cherng collector, 3 specimens (TFRI); same locality, 7.VIII.2011, J.J. Cherng collector, 2 specimens (TFRI); same locality, 23.V. 2009, J.J. Cherng collector, 2 specimens (TFRI); same locality, 17.IX. 2011, J.J. Cherng collector, 3 specimens (TFRI); same locality, 5.V. 2012, J.J. Cherng collector, 2 specimens (TFRI); same locality, 13.V. 2012, J.J. Cherng collector, 2 specimens (TFRI); same locality, 11.VII.2012, J.J. Cherng collector, 9 specimens (TFRI); same locality, 24.II.2013, J.J. Cherng collector, 1 specimen (TFRI); same locality, 27.VII.2013, J.J. Cherng collector, 3 specimens (TFRI); same locality, 3.X.2013, L.J. Wang collector, 18 specimens (CAS, CWT, TFRI); same locality, 19.X.2013, J.J. Cherng collector, 2 specimens (TFRI); same locality, 9.XI.2013, J.J. Cherng collector, 1 specimen (TFRI); same locality, 12.IV.2014, J.J. Cherng collector, 1 specimen (TFRI); same locality, 24.V.2014, J.J. Cherng collector, 2 specimens (TFRI); same locality, 24.VII.2016, J.J. Cherng collector, 1 specimen (TFRI); same locality, 25.XII.2016, J.J. Cherng collector, 5 specimens (TFRI); same locality, 7.I.2017, J.J. Cherng collector, 12 specimens (NMNS, NMW, TFRI, ZSM); same locality, 3.II.2017, J.J. Cherng collector, 6 specimens (TFRI); same locality, 4.II.2017, J.J. Cherng collector, 2 specimens (TFRI); same locality, 4.III.2017, J.J. Cherng collector, 9 specimens (TFRI). *Kinshan, Chungjiao*, 4.II.2017, J.J. Cherng collector, 10 specimens (CAS, CWT, TFRI); same locality, 12.III.2017, J.J. Cherng collector, 8 specimens (TFRI); *Danshui, Shalun*, 4.II.2017, J.J. Cherng collector, 16 specimens (TFRI); same locality, 12.III.2017, J. J. Cherng collector, 9 specimens (CAS, CWT, TFRI).



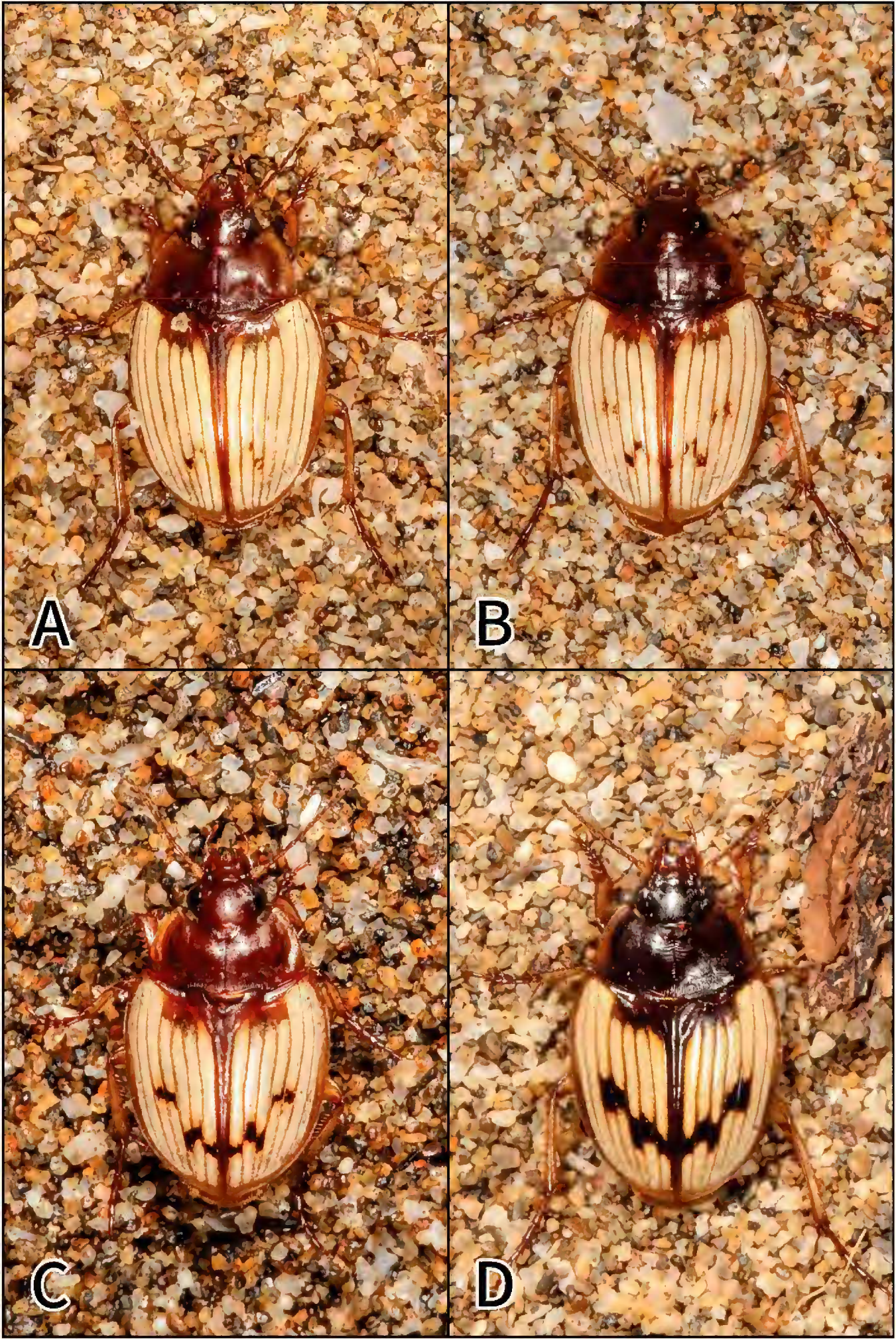


FIGURE 1. Range of variation in color pattern among adults of *Cyclosomus inustus* Andrewes in Taiwan.





FIGURE 2. Geographical distribution of *Cyclosomus inustus* Andrewes in Taiwan and the adjacent mainland. A, Shihmen. B, Danshui. C, Kinshan.



**DISTRIBUTION** (Fig. 2).— This species is now recorded from coastal mainland China (Hong Kong and Nanao Island in Guangdong Province) and the three localities in northern Taiwan presented above.

**ECOLOGICAL OBSERVATIONS.**— *Cyclosomus inustus* inhabits the sandy sea coast of northern Taiwan (Fig. 3). It has not been found on sandy beaches without at least scattered plant cover present. Coast plants in the habitat of *C. inustus* include *Casuarina equisetifolia* L., *Hibiscus tiliaceus* L., *Pandanus odoratissimus* L., *Scaevola sericea* Forst. f. ex Vahl, *Crinum asiaticum* L., *Vitex rotundifolia* L. f., *Artemisia capillaris* Thunb., *Spinifex littoreus* (Burm. f.) Merr., *Carex pumila* Thunb., *Ipomoea pes-caprae* (L.) R. Brown subsp. *brasiliensis* (L.) Oostst, *Vigna marina* (Burm.) Merr., *Tetragonia tetragonoides* (Pall.) Kuntze, *Oenothera laciniata* J. Hill, *Ixeris debilis* (Thunb.) A. Gray, and *Ixeris repens* (L.) A. Gray. This habitat is apparently quite different from that of all the other *Cyclosomus* species for which habitat information is available. All others apparently favor the exposed sandy banks of mid- to large-size rivers or sandy lake shores (Kavanaugh, 2015).

Adults of *C. inustus* have been observed in every month of the year. Like other congeneric species, they are active on the surface at night and hidden in the sand during the day. They are markedly and negatively phototaxis insects. At night, during their activity period, they are quick to burrow into the sand (Fig. 5A) if illuminated directly by the light of a flashlight. The earliest time at which adults have been observed active on the sand surface is 5:52 pm, just after sunset, in January, 2017. We observed that adults appear on the surface of the sand when the temperature on the beach is above 15°C (observations from three collecting sites during January through March). Although Nietner (1857) found adults of *Cyclosomus flexuosus* (Fabricius) hiding in the “driest, hottest and sandiest places that can be found” on the western coast of Sri Lanka, we have not yet determined the upper thermal tolerance of *C. inustus* in Taiwan or elsewhere.

In Taiwan, *C. inustus* adults have been observed in the field feeding on beetles, flies, and shield bugs (Figs. 5B–D). When maintained in the laboratory, they will not feed on live termites or caterpillars but will eat these same insects soon after they are dead. Consequently, we suggest that they are primarily scavengers, rather than predators.

Other carabid species found occupying the same habitat as *C. inustus* in northern Taiwan (i.e., are syntopic with this species) include *Bembidion fusiforme* Netolitzky (Fig. 6A), *Abroscelis anchoralis anchoralis* (Chevrolat) (Fig. 6C), *Calomera angulata* (Fabricius) (Fig. 6E), *Cicindela batesi* Fleutiaux (Fig. 6G) and *Cylindera kaleea angulimaculata* (Mandl) (Fig. 6H). Adults of all of these species are diurnally active and only those of *Bembidion fusiforme* are also active at night (at least in some parts of Taiwan). For completeness, we provide below a checklist of all the carabid species observed during our study in sandy sea beach habitats in northern Taiwan.

**A checklist of carabid species found during 2005-2017  
in sandy sea beach habitats of northern Taiwan**

1. *Cyclosomus inustus* Andrewes (Fig. 1A-D)
2. *Bembidion fusiforme* Netolitzky (Fig. 6A)
3. *Mastax brittoni* Quentin (Fig. 6B)
4. *Abroscelis anchoralis anchoralis* (Chevrolat) (Fig. 6C)
5. *Abroscelis anchoralis punctatissima* (Schaum) (Fig. 6D)
6. *Calomera angulata* (Fabricius) (Fig. 6E)
7. *Cicindela batesi* Fleutiaux (Fig. 6G)
8. *Cylindera kaleea angulimaculata* (Mandl) (Fig. 6H)
9. *Lophyra cancellata subtilesculpta* (W. Horn) (Fig. 6F)
10. *Myriochile speculifera* (Chevrolat)



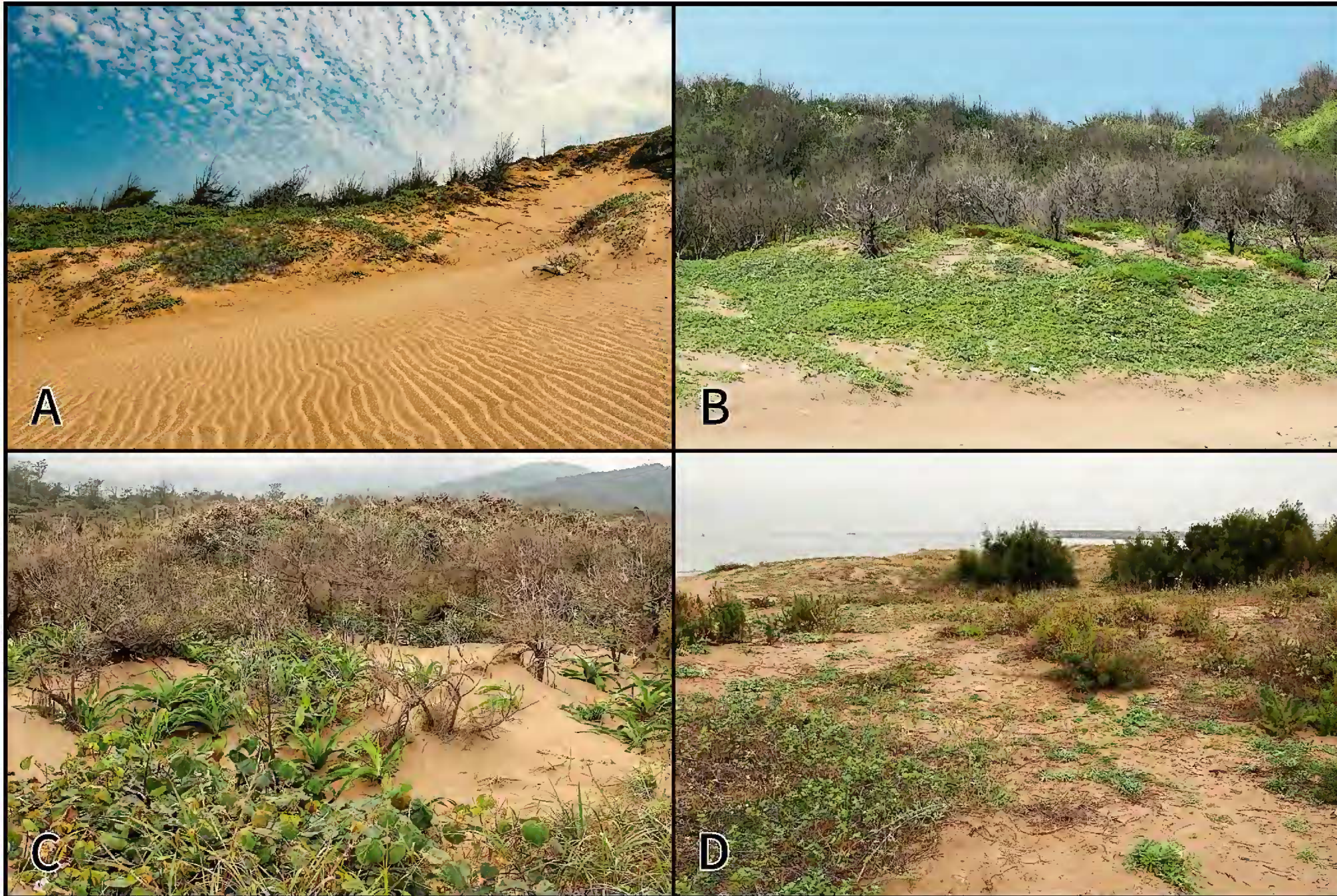


FIGURE 3. Habitats of *Cyclosomus inustus* Andrewes in Taiwan. A-B, Shihmen. C, Kinshan. D, Danshui.



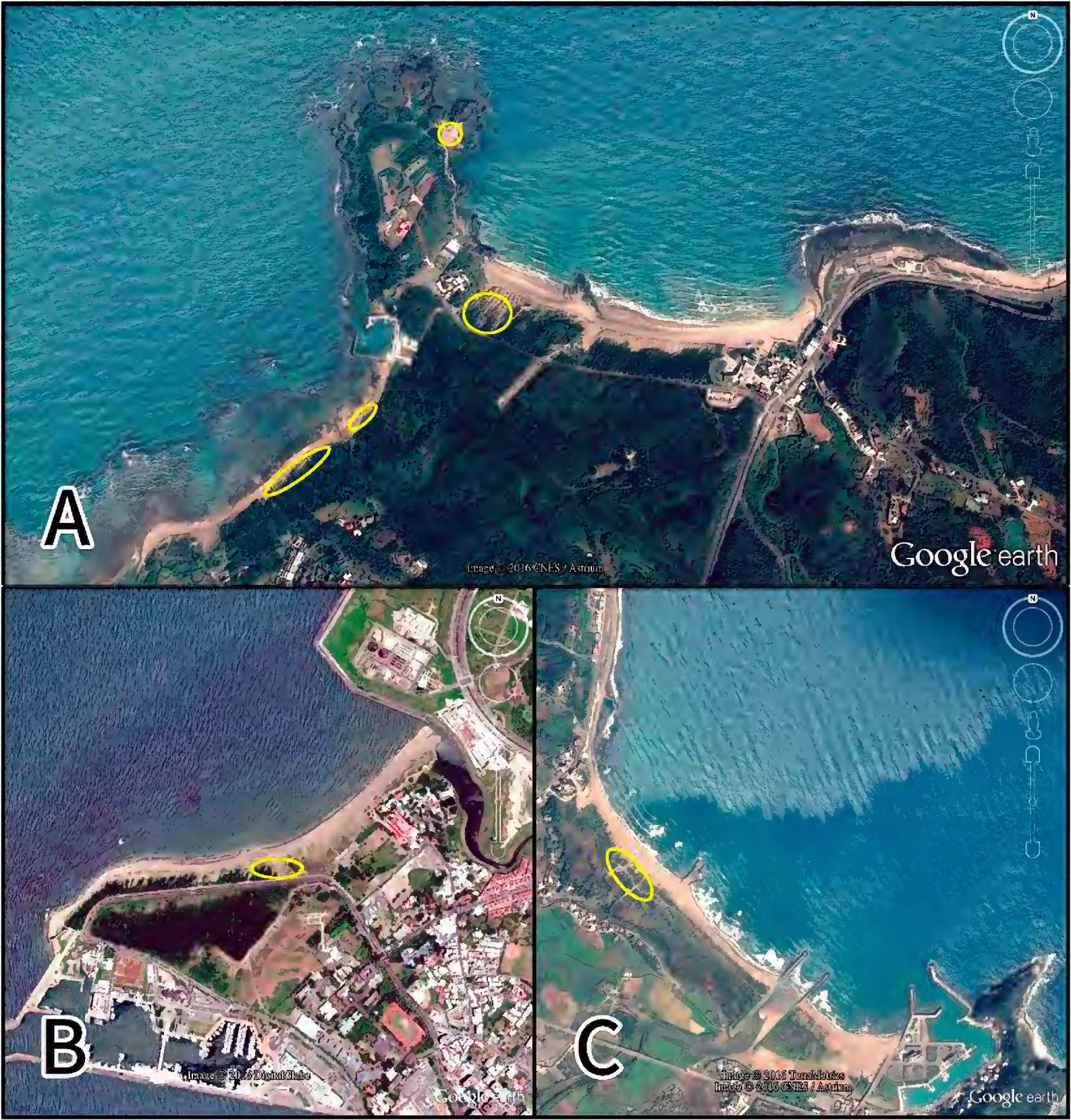


FIGURE 4. Distribution of habitats of *Cyclosomus inustus* Andrewes in Taiwan. A, Shihmen. B, Danshui. C, Kinshan. Areas outlined in yellow indicate the areas of the stabilized dunes where the beetles have been found (see also Fig. 3)..



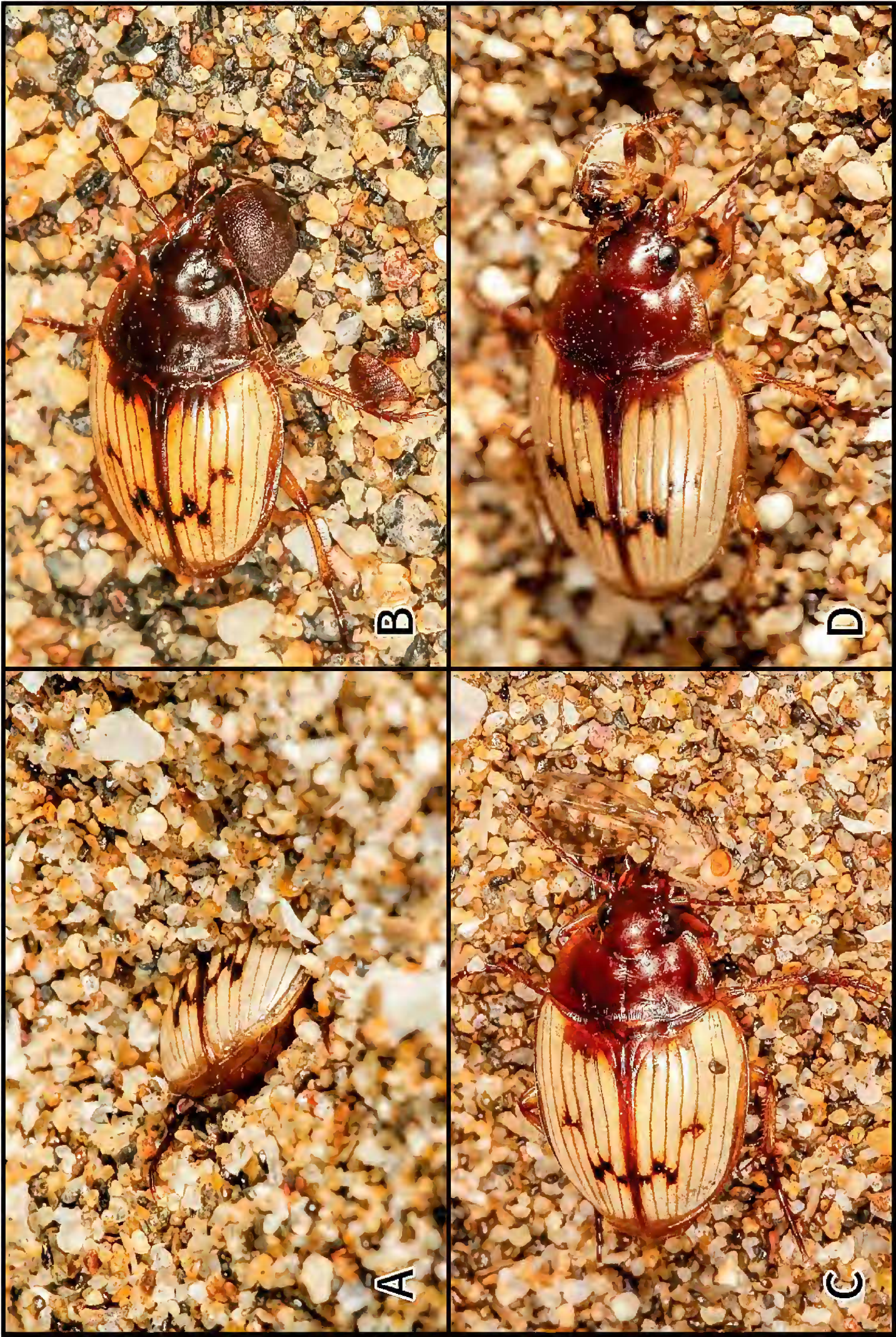


FIGURE 5. *Cyclosomus inustus* Andrewes in Taiwan. A. Adult burrowing into sand, demonstrating negative phototaxis. B-D Adult feeding. B. On a small beetle (Tenebrionidae: *Nesocaeidius* sp.). C. On a nymphal shield bug (Cydnidae).



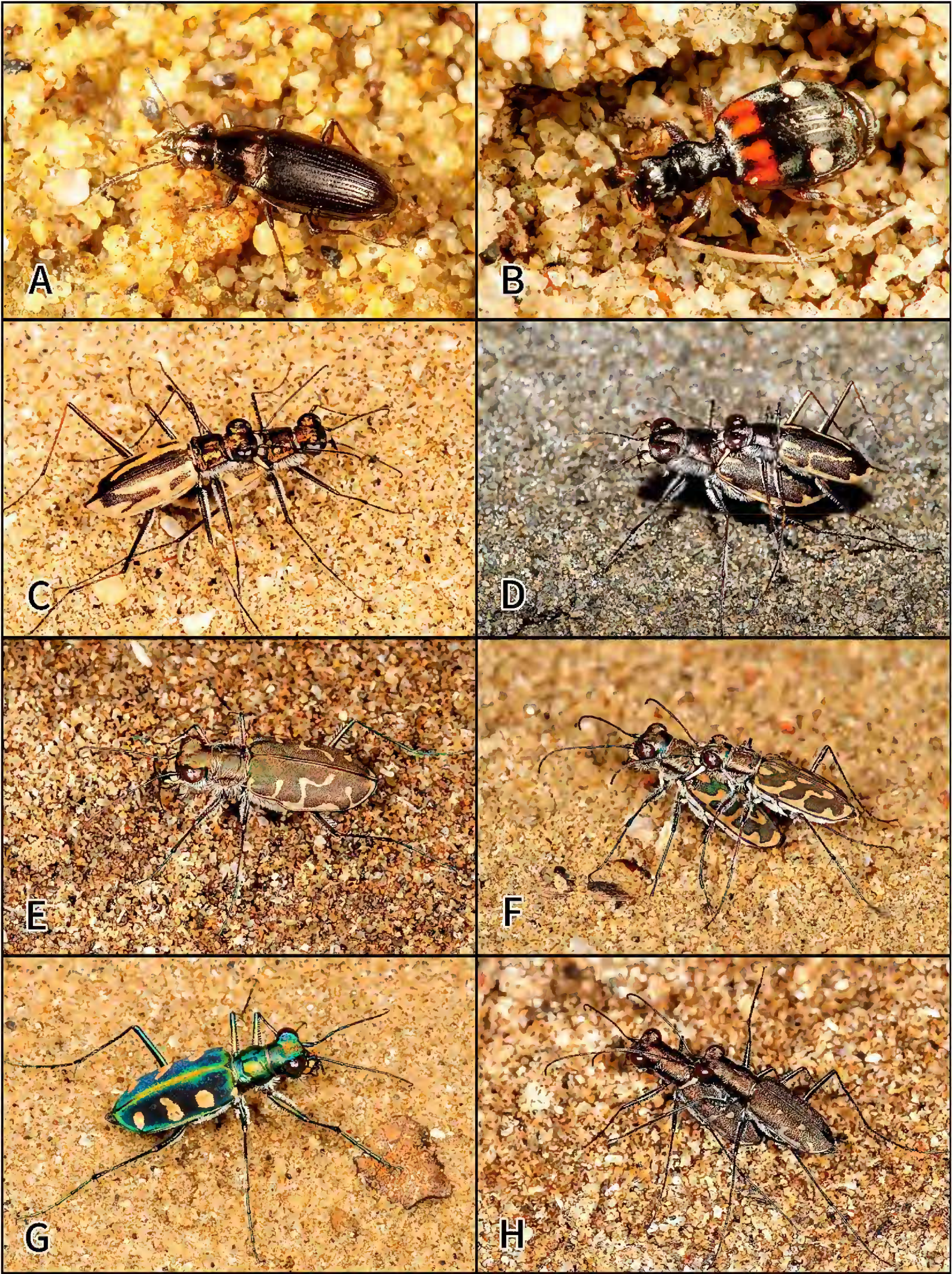


FIGURE 6. Other carabid species active on coastal sand in northern Taiwan. A. *Bembidion fusiforme* Netolitzky. B. *Mastax brittoni* Quentin. C. *Abroscelis anchoralis anchoralis* (Chevrolat). D. *Abroscelis anchoralis punctatissima* (Schaum). E. *Calomera angulata* (Fabricius), F. *Lophyra cancellata subtilesculpta* (W. Horn). G. *Cicindela batesi* Fleutiaux. H. *Cylindera kaleea angulimaculata* (Mandl).



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